Kelly KDHE High Power Series/PM Motor Controller User's Manual

KDH12101E
KDH12121E
KDH12151E
KDH12181E
KDH14601E
KDH14801E
KDH14101E
KDH14121E

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Chapter 1 Introduction

1.1 Overview

The manual introduces Kelly KDHE High Power motor controllers' features, installation and maintenance. Read the manual carefully and thoroughly before using the controller. If you have any questions, please contact the support center of Kelly Controls, LLC.

Kelly's programmable motor controllers provide efficient, smooth and quite controls for electrical vehicles like golf cart, go-cart, electric motorcycle, fork lift, hybrid vehicle, as well as electric boat and industry motor speed control. It uses high power MOSFET, fast PWM to achieve efficiency 99% in most cases. Powerful microprocessor brings in comprehensive and precise control to the controllers. It also allows users to set parameters, conduct tests, and obtain diagnostic information quickly and easily.

Chapter 2 Main Features and Specifications

2.1 General functions

(1) Extended fault detection and protection. LED flashing code indicates fault sources.
(2) Monitoring battery voltage. It will stop driving if battery voltage is too high. It will cut back then stop driving if voltage is going too low.
(3) Built-in current loop and over current protection.
(4) Controller temperature measurement and protection.
(5) Cutting back current at low temperature and high temperature to protect battery and controller. The current will ramp down quickly if controller temperature is higher than 90℃, and shutdown at 100℃. Low temperature current ramping down usually starts at 0℃.
(6) The controller keeps monitoring voltage during regen. It will cut back current then cut off regen if voltage is going too high.
(7) Configurable to limit max reverse speed to half of max forward speed.
(8) Configurable and programmable with RS-232. Software upgradeable. Windows GUI provided.
(9) Provide 5V sensor supply.
(10) 3 switch inputs : Default to throttle switch, brake switch and reverse switch. Closing to ground is to activate.
(11) 3 analog inputs, 0-5V: Default to throttle input, brake input and motor temperature input.
(12) Reverse alarm output: Recirculation diodes provided.
(13) Main contactor driver: Cutting off the power if any fault is detected.
(14) Configurable max reverse power to half.
(15) Thermal overload detection and protection to safeguard the motor from over temperature, with recommended Silicon temperature sensors KTY83-122.
(16) Optional CAN bus.
(17) Supply voltage 10V-30V.

Caution! Regeneration has braking effect, but can't replace mechanical brake. Mechanical brake is required to stop your vehicle. Regen isn't a safety feature! Controller may stop regen to protect itself (not you!).

2.2 Features

•Opto-isolated technology achieve stability.
•Intelligence with powerful microprocessor.
•Synchronous rectification, ultra low drop, and fast PWM to achieve very high efficiency.
•Current limit and torque control.
•Low EMC.
•LED fault code helps user debugging.
•Battery protection: current cut back, shutdown and warning at low battery.
• Rugged aluminum housing for maximum heat dissipation.
•Thermal protection: Current cutback at low temperature and high temperature to protect

battery and controller.
•High pedal protection: Disable operation if power up with non-zero throttle.
•Brake switch is used to start regen.
•0-5V brake signal is used to command regen current.
•Easy installation: 1-4V "Hall Active" throttle or "3 Wire" potentiometer(<100K) can work.

2.3 Specifications

•Frequency of Operation: 16.6kHz.
•Standby Battery Current: less than 1 mA.
•Supply Voltage, PWR, 10 to 30V(24V is preferred).
•Supply Current, 200mA @ 12V, or 2.5W
•Operating Voltage, B+, 18V-136V for 120V controllers;18V to 180V for 144V controllers.
•Standard Throttle Input: 0-5 Volts(3-wire resistive pot), 1-4 Volts(hall active throttle).
•Analog Brake and Throttle Input: 0-5 Volts. Producing 0-5V signal with 3-wire pot.
•Reverse Alarm, Main Contactor Coil Driver, Meter.
•Full Power Temperature Range: 0℃ to 50℃ (controller case temperature).
•Operating Temperature Range: -30℃ to 90℃, 100℃ shutdown (controller case temperature).
•Motor Current Limit,1 minutes: 600A - 1800A, depending on the model.
•Motor Current Limit, continuous:240A - 720A, depending on the model.

Chapter 3 Wiring and Installation

3.1 Mounting the Controller

The controller can be oriented in any position as clean and dry as possible, or shield with a cover to protect it from water and contaminants.

To ensure full rated output power, the controller should be fastened to a clean, flat metal surface with several screws. Applying silicon gel or other thermal conductive material to contact surface will enhance thermal performance.

Sufficient heat sink and air flow is required for high power application.

The case outline and mounting holes' dimensions are shown in Figure 1,2.

Caution:

- **RUNAWAYS** — Some conditions could cause the vehicle to run out of control. Disconnect the motor, or jack up the vehicle, and get the drive wheels off the ground before attempting any work on the motor control circuitry.
- **HIGH CURRENT ARCS** — Electric vehicle batteries can supply very high power, and arcs can occur if they are short circuit. Always turn off the battery circuit before working on the motor control circuit. Wear safety glasses, and use properly insulated tools to prevent short.

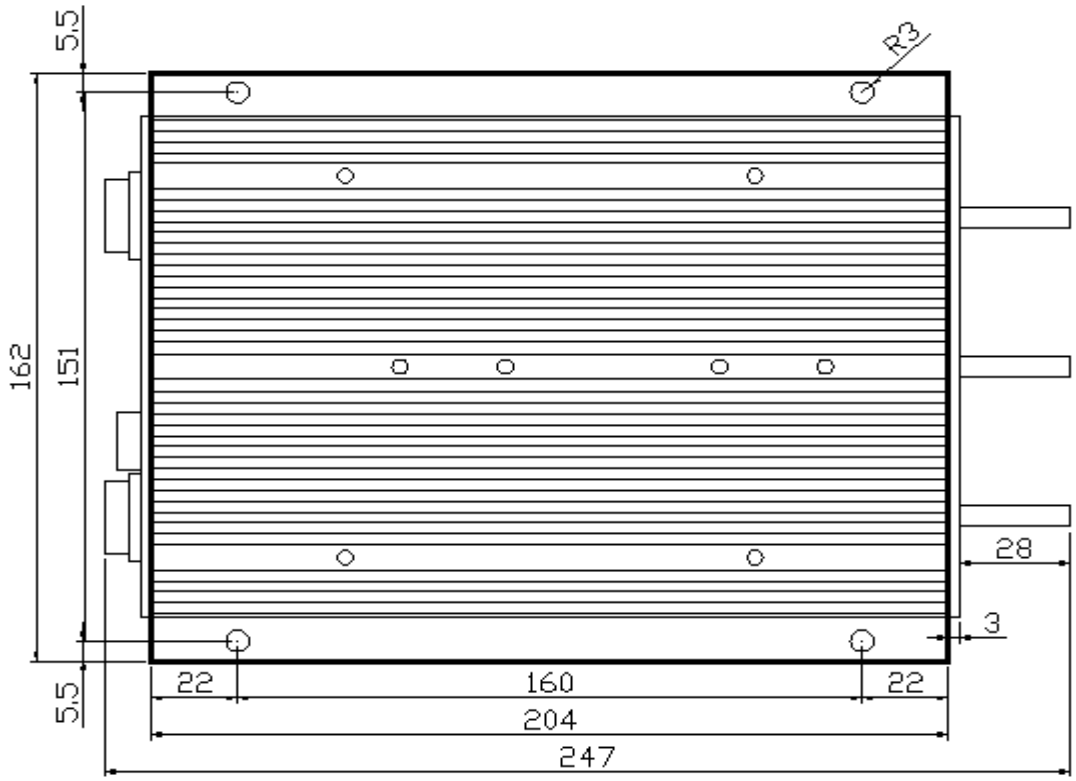

Figure 1: Height: 84 millimeters
Length: 204 millimeters

Controller models with above dimension: KDH12101E, KDH12121E,
KDH14601E, KDH14801E

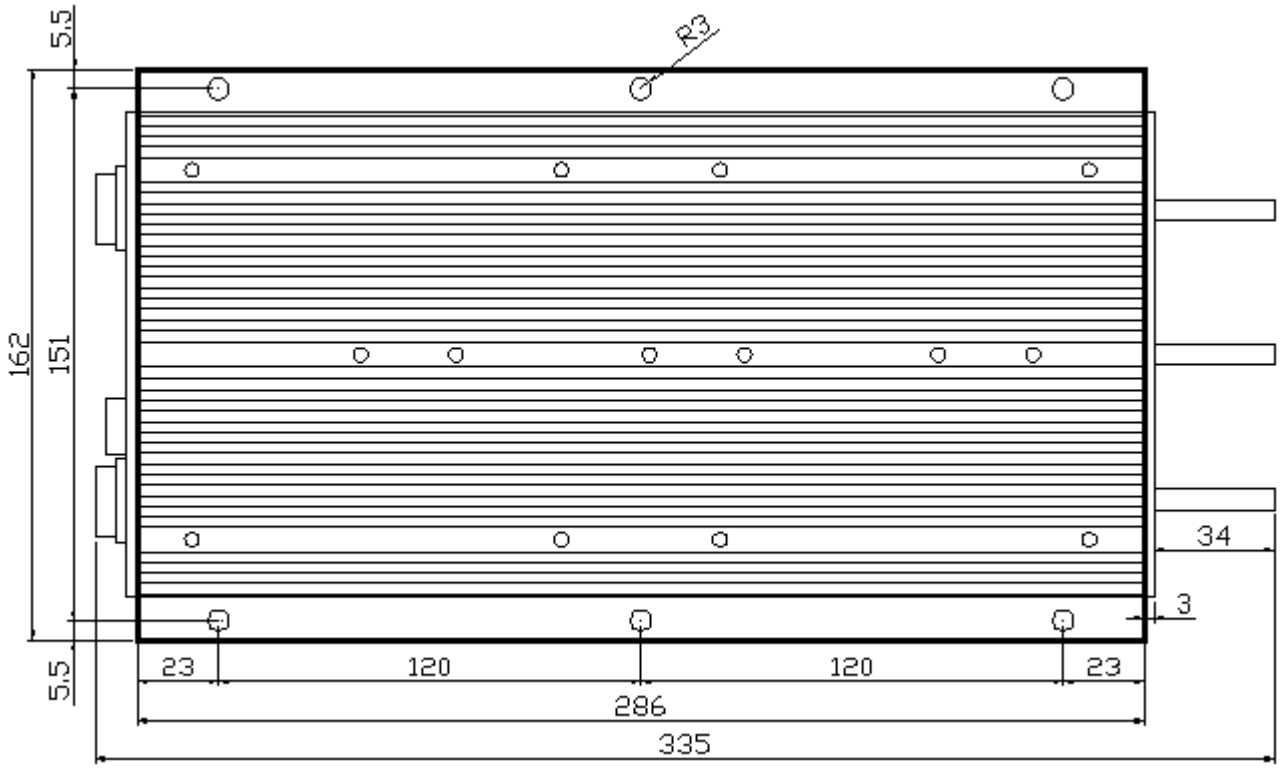

Figure 2: Height: 84 millimeters
Length: 286 millimeters
Controller models with above dimension: KDH12151E, KDH12181E
KDH14101E, KDH14121E

3.2 Connections

3.2.1 Panel of KDHE Motor Controller:

Three metal bars and two plugs (J1, J2) are provided for connecting to the battery, motor and control signals shown as Figure 3 and Figure 4.

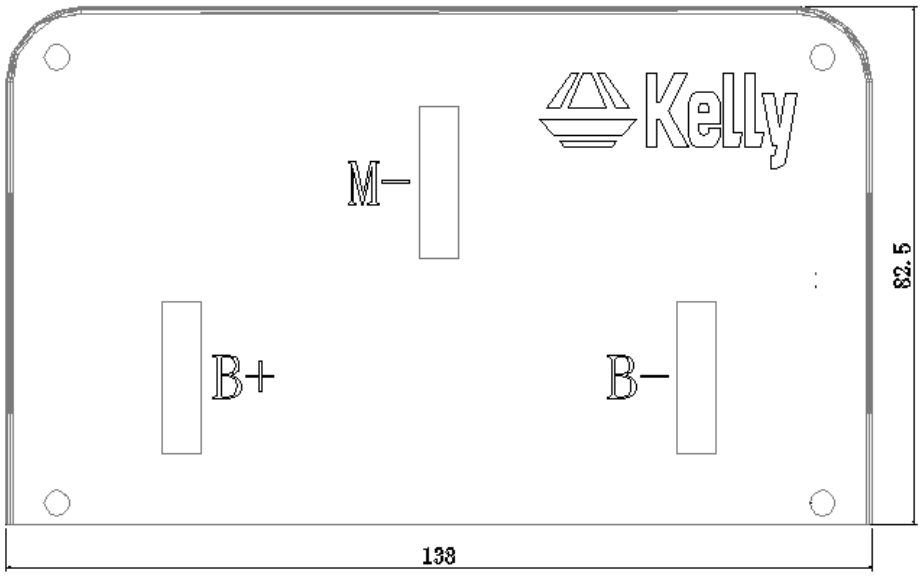

Figure 3: Front panel of KDHE motor controller

B+: battery positive and armature positive
B-: battery negative
M-: armature negative

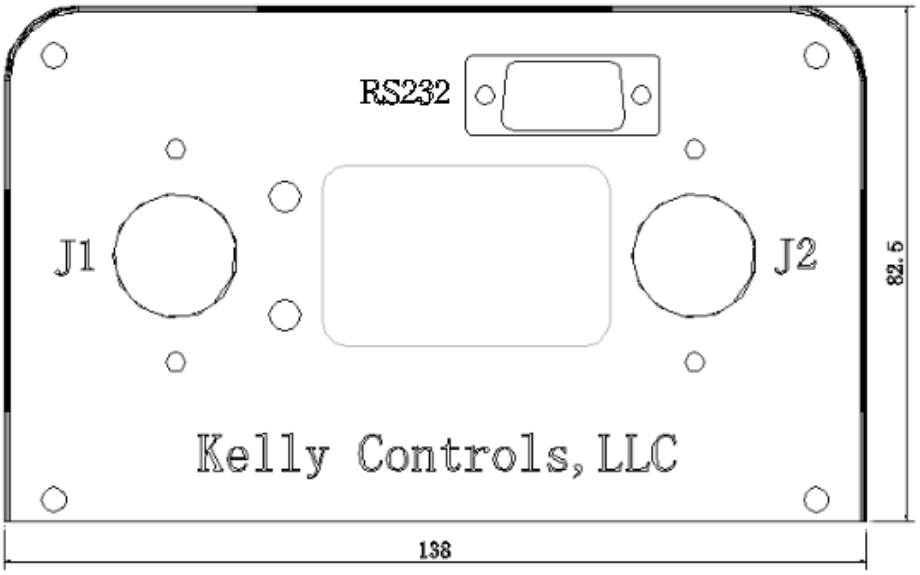

Figure 4: Back panel of KDHE motor controller

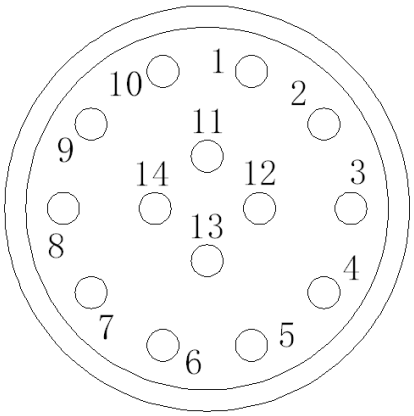

Figure 5: The connecting diagram of **J1** and **J2**

J1 Pin Definition

1- **PWR: Controller power supply (output).**
2- **Current meter. <200mA**
3- **Main contactor driver. <1.5A**
4- **Alarm: To drive reverse beeper, <200mA.**
5- **GND: Signal return**
6- **Green LED: Running indication**
7- **GND: Signal return**

8- Reserved
9- Reserved
10- CAN bus high. Optional
11- CAN bus low. Optional
12- Reserved
13- GND: Signal return, or power supply ground
14- Red LED: Fault code.

J2 Pin Definition

1- PWR: Controller power supply (input)
2- GND: Signal return, or power supply ground
3- GND: Signal return
4- Motor temperature input.
5- Throttle analog input, 0-5V
6- Brake analog input, 0-5V
7- 5V: 5V supply output. <40mA
8- Micro_SW: Throttle switch input
9- Reverse switch input
10- Brake switch input
11- Reserved
12- Reserved
13- Reserved
14- GND: Signal return

Notes:

1. All RTN pins are internally connected.
2. Two PWR pins, J1-1 and J2-1, are internally connected. It's recommended to use J1-1 to supply peripherals like alarm and contactor. Twist peripheral wires with PWR is the preferred for EMC. Recirculation diodes are provided in the controller to PWR for alarm and Contactor coil driver.
3. Kelly Ampmeter positive connect to 5V power supply of controller, negative to J1-2.
4. Switch to ground is active. Open switch is inactive.

Caution: Make sure all connections are correct before applying power. Otherwise it may damage the controller! Please securely wire B- before applying power. It's preferred to place contactor or breaker on B+. Don't connect RTN to B-.Please place precharge resistor on any breaker! It can cause damage without it!!!

3.2.2 Standard Wiring of KDHE Motor Controller

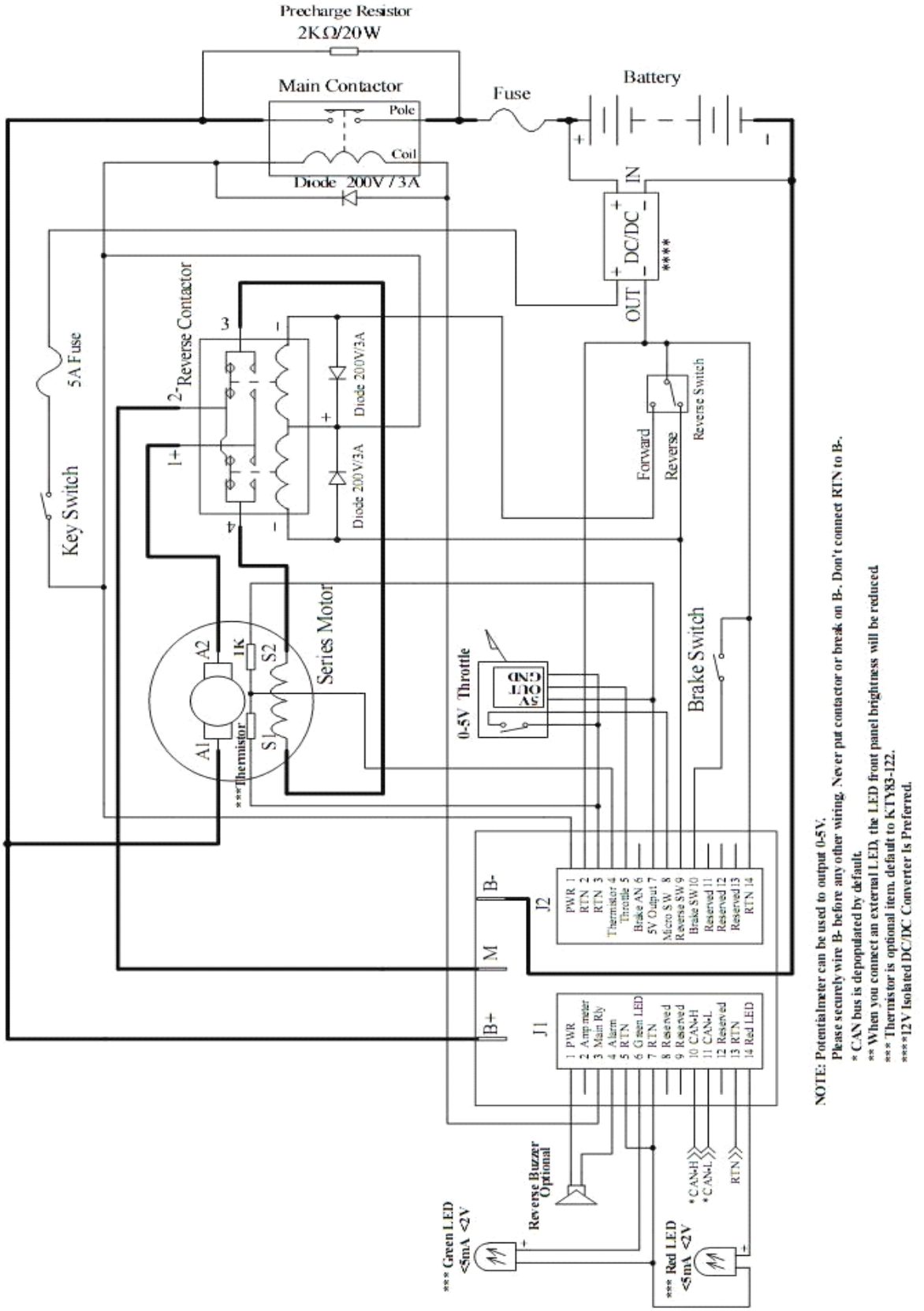

Figure 6: KDHE Series motor controller standard wiring

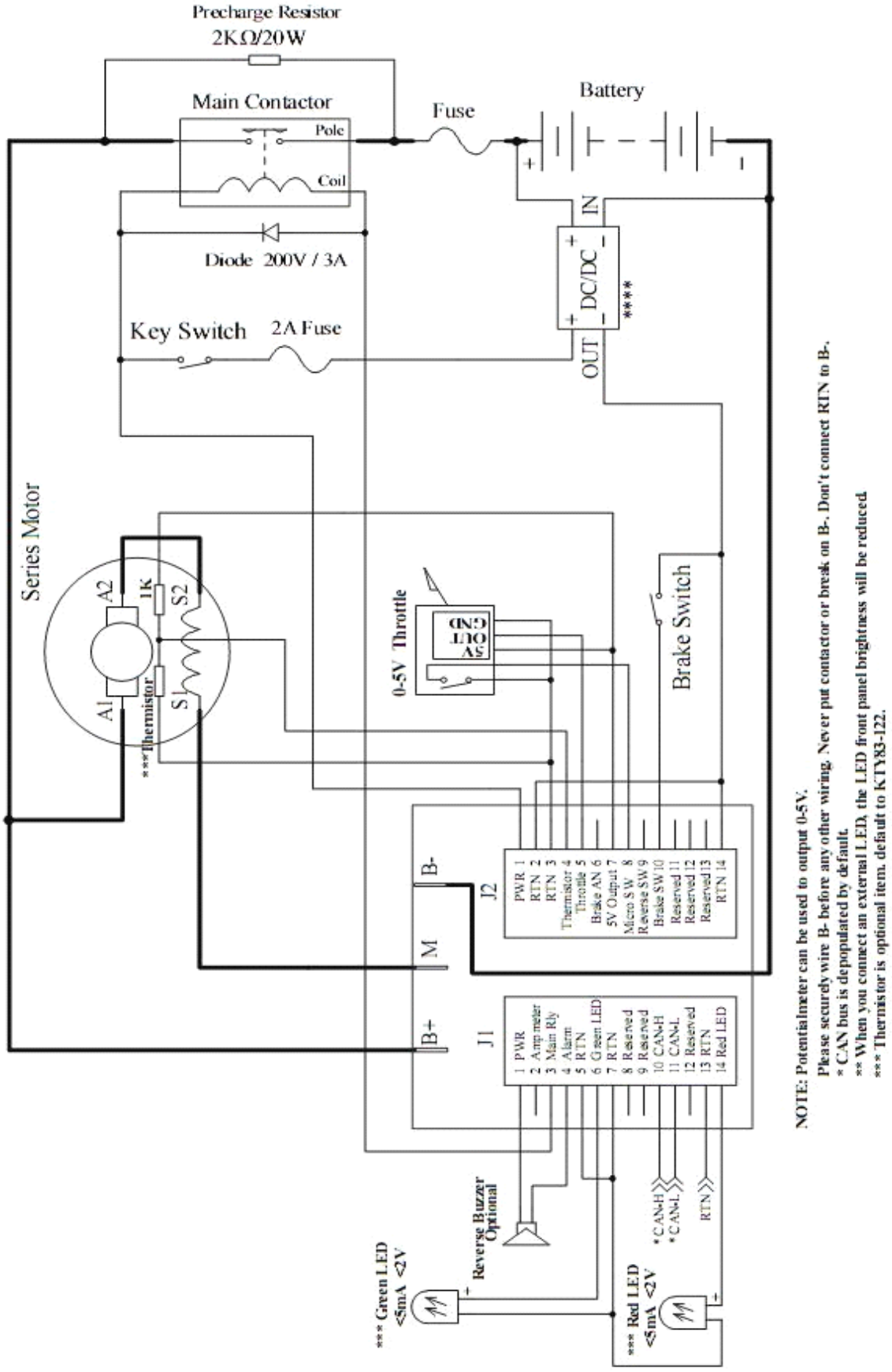

Figure 7: KDHE Series motor controller standard wiring without Reversing Contactor

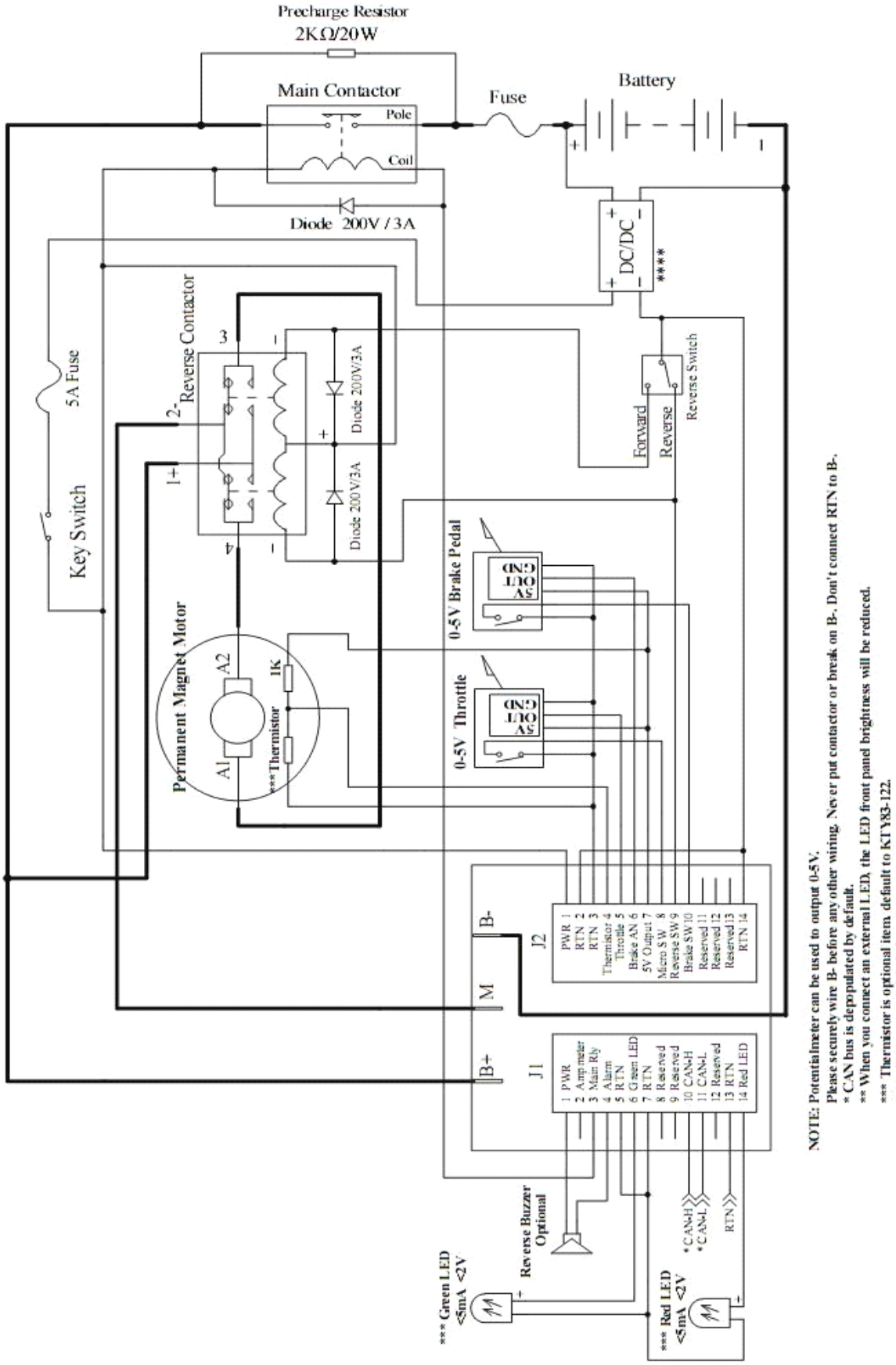

Figure 8: KDHE PM motor controller standard wiring

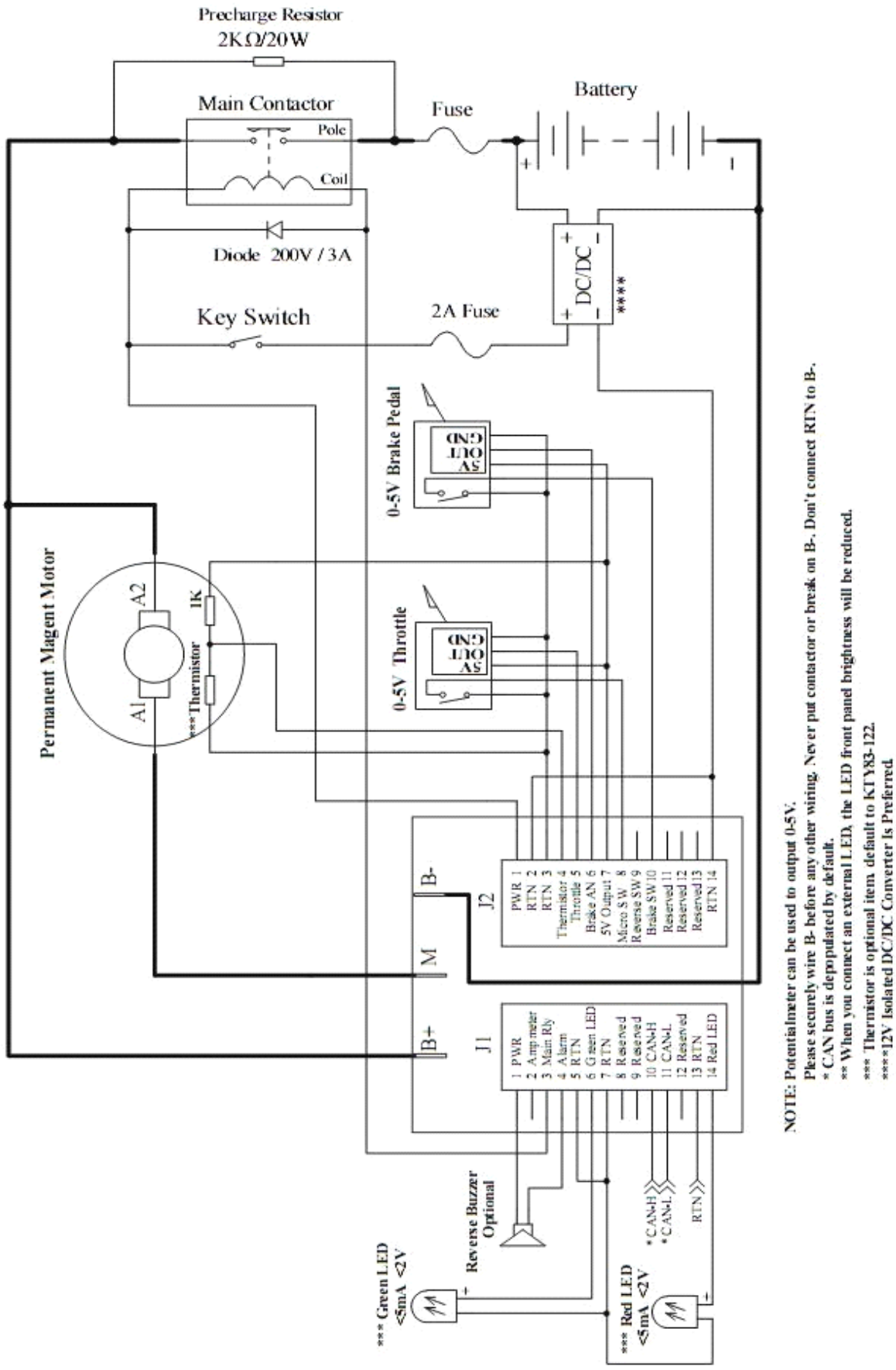

Figure 9: KDHE PM motor controller standard wiring without Reversing Contactor

3.2.3 Communication Port

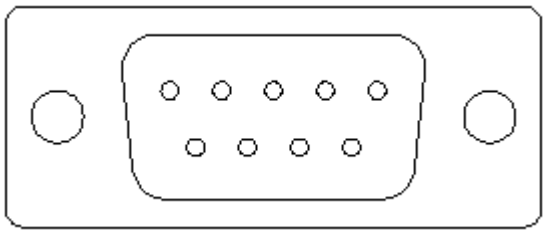

Figure 10: standard RS232 interface

3.3 Installation Checklist

Before operating the vehicle, complete the following checkout procedures. Use LED code as a reference. The LED codes are listed in Table 1.

Caution:
- Put the vehicle up on blocks to get the drive wheels off the ground before beginning these tests.
- Do not allow anyone to stand directly in front of or behind the vehicle during the checkout.
- Make sure both the PWR switch and the brake are off
- Use well-insulated tools.

- Make sure the wire is connected correctly
- Turn the PWR switch on. The LED should blink, then keep on when the controller operates normally. If this does not happen, check continuity of the PWR and controller ground.
- The fault code will be detected automatically at restarting.
- With the brake switch open, select a direction and operate the throttle. The motor should spin in the selected direction. Please verify wiring and voltage if it doesn't operate. Also check fuse. The motor should run faster with increasing throttle. If not, refer to Table 1 LED code, and correct the fault according to the code.
- Take the vehicle off the blocks and drive it in a clear area. It should have smooth acceleration and good top speed.

Chapter 4 Maintenance

There are no user-serviceable parts inside the controllers. Do not attempt to open the controller, or you will damage it. However, clearing the controller exterior periodically should be necessary.

The controller is inherently a high power device. When working with any battery powered vehicle, proper safety precautions should be taken. These include, but are not limited to: proper training, wearing eye protection, avoiding loose clothing and jewelry, and using insulated wrenches.

4.1 Cleaning

Although the controller requires virtually no maintenance after properly installation, the following minor maintenance is recommended in certain applications.

- Remove power by disconnecting the battery.
- Discharge the capacitors in the controller by connecting a load (such as a contactor coil or a horn) across the controller's B+ and B- terminals.
- Remove any dirt or corrosion from the bus bar area. The controller should be wiped down with a moist rag. Be sure it is dry before reconnecting the battery.
- Make sure the connections to the bus bars are tight. Use two wrenches for this task in order to avoid stressing the bus bars; the wrenches should be well insulated.

4.2 Configuration

You can configure the controller with a host computer through RS232.

- Use a standard RS232 cable connecting the 9pin connector on face penal to a host computer. The cable should be straight.
- Provide 10V to 30V supply to PWR (either J2 pin1 or J1 pin1). Wire power supply ground to any RTN pin.
- Do not connect B+, throttle and so on. The controller may display fault code, but it doesn't affect programming or configuration.

Download and setup the configuration software：

http://www.newkellycontroller.com/support.php

Table 1: LED CODES

Green LED Code

LED Code	Explanation	Solution
Green Off	No power or not operating	1. Check if all wires are correct. 2. Check fuse and power supply.
Green On	Normal operation	That's great! You got solution!
Green and Red LED Keep On		1. Software is upgrading. 2. Supply voltage too low or battery too high 3. The controller is damaged. Please contact Kelly for warrantee.

Red LED Code

LED Code		Explanation	Solution
1,2	¤ ¤¤	Over voltage error	1. Battery voltage is higher than max operating voltage of the controller. Please check the battery voltage and configuration. 2. Over voltage at regeneration. Controller will cut back or stop regeneration. 3. Please note there could be 2% error with Overvoltage setting.
1,3	¤ ¤¤¤	Low voltage error	1. The controller will attempt to clear the fault code automatically after 5 second if battery voltage returns to normal. 2. Check the battery voltage. 3. Charge battery if necessary.
1,4	¤ ¤¤¤¤	Over temperature warning	1. The controller temperature is over 90℃. The controller will cut back current in the case. Stop or reduce output to ensure the temperature fall.
2,2	¤¤ ¤¤	Internal voltage fault	1. Check if the B+ and PWR voltage are correct, refer to B- or RTN. Could be PWR voltage low. 2. Please check load on 5V supply. Could be high load on 5V. Incorrect pot wiring can load it heavily. 3. The controller is damaged. Please contact Kelly for warrantee.
2,3	¤¤ ¤¤¤	Over temperature	1. The controller temperature is over 100℃. Controller stops driving in order to protect itself. 2. Stop driving and wait for temperature fall. The controller will restart if temperature drops below 80℃.

2,4	¤¤ ¤¤¤¤	Throttle error at power up	1. The throttle signal is higher than configured dead zone at power-on 2. The fault will disappear if restarts or releases throttle. 3. Configure throttle model as "Hall Active" throttle if you use that throttle model.
3,1	¤¤¤ ¤	Frequent reset	It can be caused by over current, bad motor, bad ground wiring or so.
3,2	¤¤¤ ¤¤	Improper throttle model	Configure throttle model as "3 Wire" hall if you use that throttle model.
3,3	¤¤¤ ¤¤¤	Brake pedal sensor fault	1. Check and make sure wiring is correct. 2. Check whether connect to right pedal model.
3,4	¤¤¤ ¤¤¤¤	Throttle isn't zero when try to change direction	The controller won't change drive direction if throttle isn't zero. Also it won't change direction at high speed. The controller will wait throttle and speed close to zero before changing direction.
4,1	¤¤¤¤ ¤	Over voltage at startup or regeneration	The controller won't drive motor if detects overvoltage at power up. It will cut back regen current or stop regen if detects overvoltage during regen. You may set overvoltage threshold with GUI. The max threshold is about 1.25 times of controller rated voltage. I.e. you may set threshold lower than 60V for 48V controller.
4, 3	¤¤¤¤ ¤¤¤	Motor over temperature	1.The motor temperature is higher than configured max temperature. Controller will shut down and wait for motor temperature dropping. 2.Can change the temperature setting with configuration program.
The Red LED flashes once at power on, then keeps off for normal operation. "1, 2" means it flashed once, then flashes twice after 1 second. The time between two flashes is 0.5 second. The pause time between one error code and another error code is 2 second.			

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